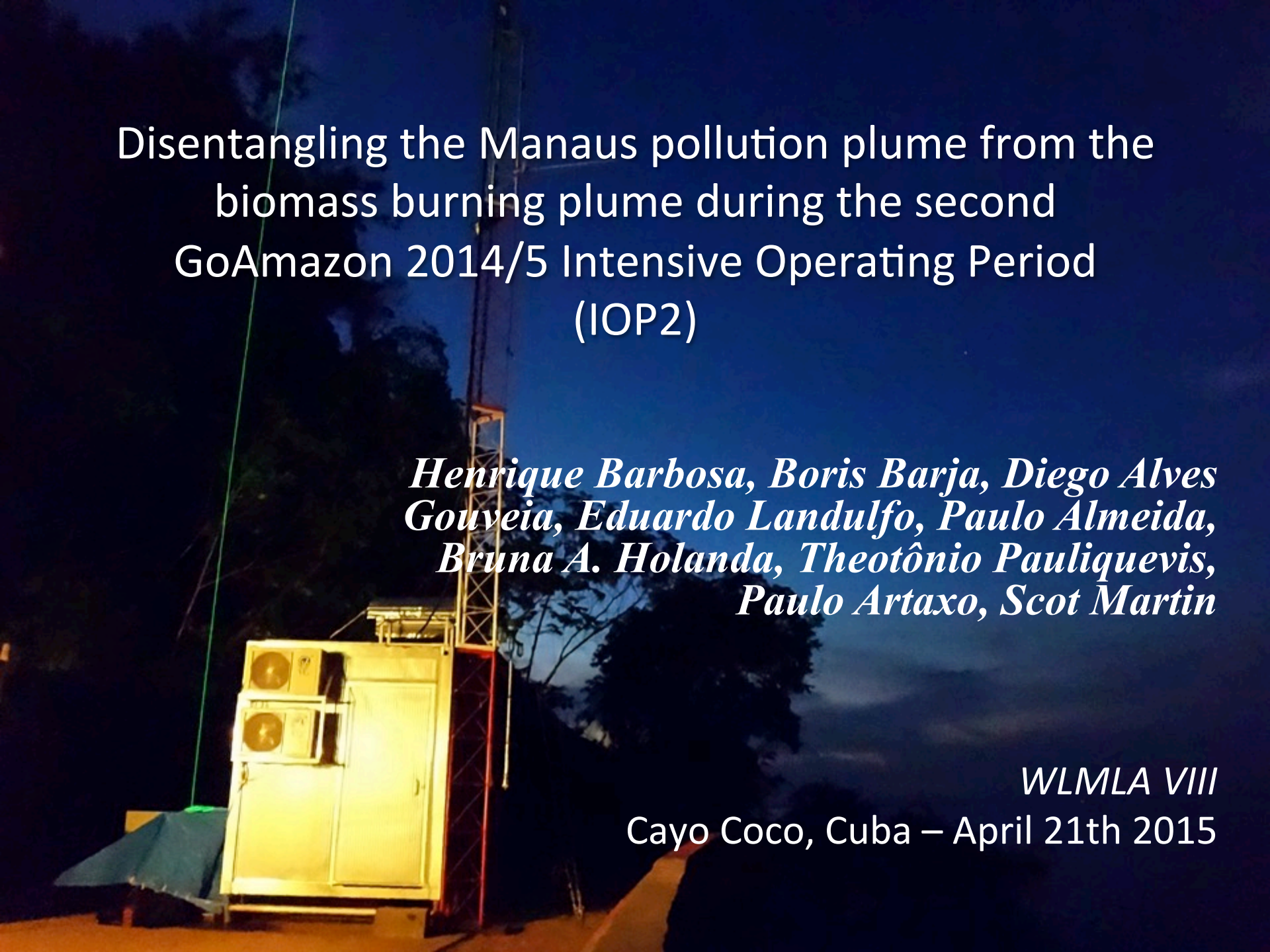


Disentangling the Manaus pollution plume from the biomass burning plume during the second GoAmazon 2014/5 Intensive Operating Period (IOP2)

Henrique Barbosa, Boris Barja, Diego Alves Gouveia, Eduardo Landulfo, Paulo Almeida, Bruna A. Holanda, Theotônio Pauliquevis, Paulo Artaxo, Scot Martin

WLMLA VIII

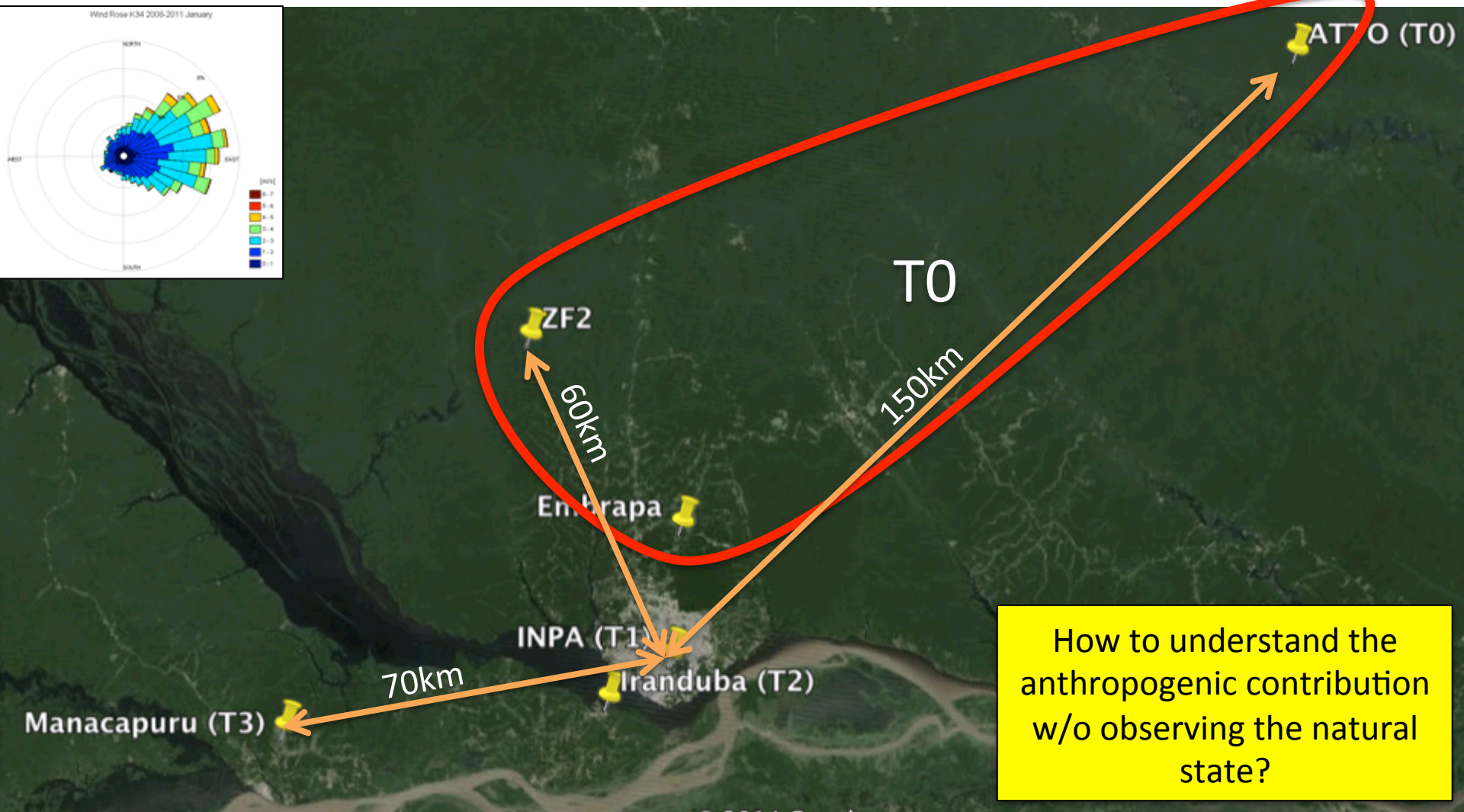
Cayo Coco, Cuba – April 21th 2015

Goals of GoAmazon

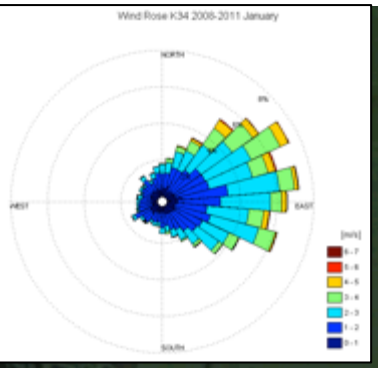
1. to **measure and understand** the factors affecting **particle size distribution** over a tropical rain forest, especially **the effects of anthropogenic pollution** as a perturbation to natural state;
2. to **develop and implement** an **upscaling** analysis from above results to prognosticate possible **climatic impacts** of present-day urban pollution and possibly greater pollution in the future.

The GoAmazon 2014/15 project

Experimental Sites



Experimental Sites



O (T0)

UEA, INPA, USP, MaxPlanck

USP, INPA, INPE, PenState

Embr

USP, INPE, MaxPlanck

INPA (T

UEA, INPA

randuba (T2)

USP

DOE+Many

Manacapuru (

Measurements Up/Down wind

- Size distribution: T3, **T2**, ZF2, **ATTO**
- Optical properties: T3, **T2**, Embrapa, ZF2, **ATTO**
- **Vertical profiles:** T3, **T2, Embrapa**
  - **Lidar,** Ceilometer …
- Precursors: T3, T2, T1, ZF2, ATTO
- Cloud related: T3, T2, Embrapa, ATTO
  - Size resolved CCN, Ceilometer, Radar, …

T0 site - ATTO

- 76 m tower
- Suite of aerosol and gas-phase measurements
- Free from local pollution

T0 Embrapa, upwind but close

- Mostly remote sensing instruments for aerosols and clouds
- Upwind of Manaus

T2 site – Close to Manaus

- 12 m tower
- Suite of aerosol and gas-phase measurements
- Little to none local emissions
- Meeting point of dolphins , alligators, monkeys, etc.

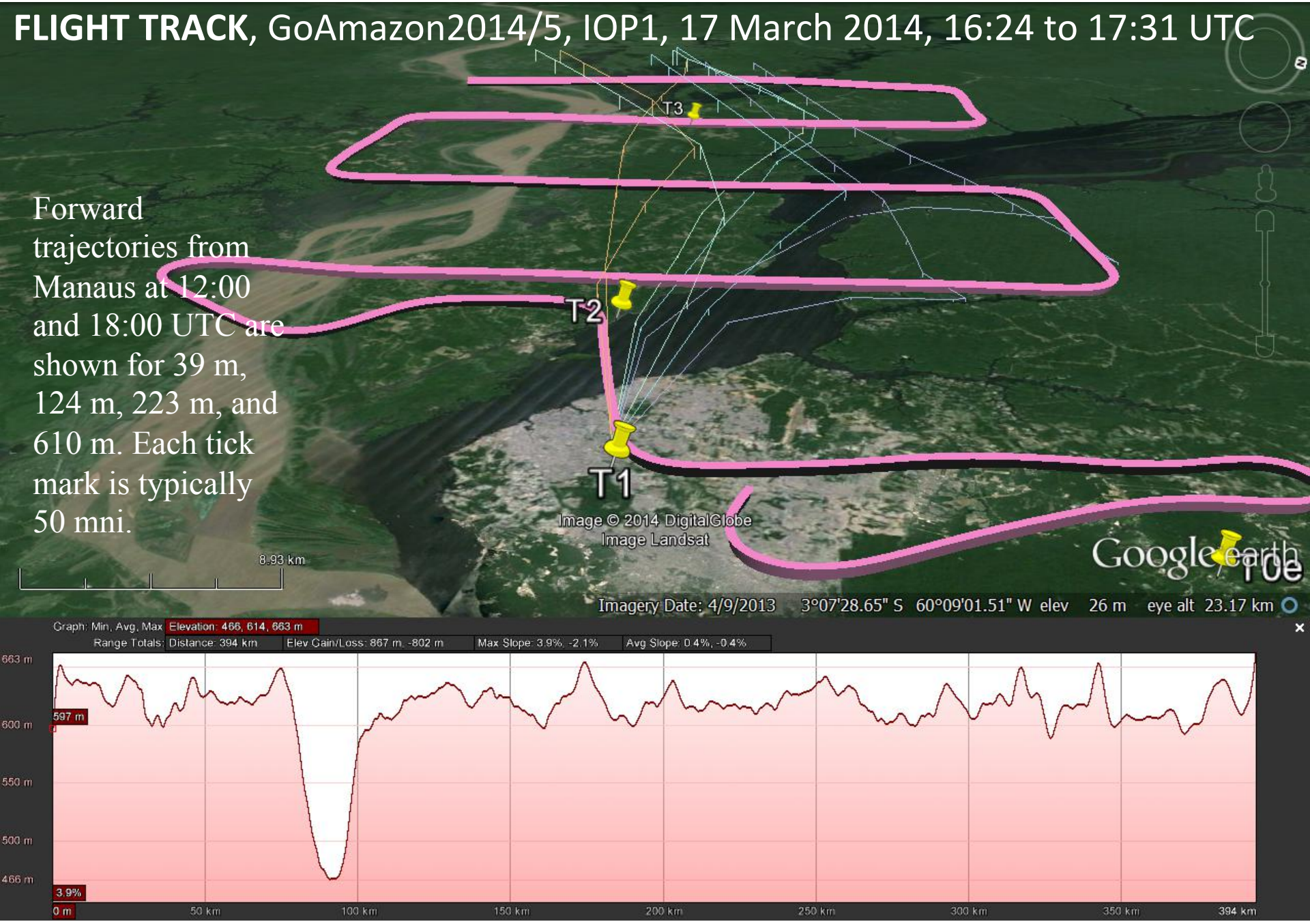
Intensive Airborne Research in Amazonia (IARA)

G1 Aircraft

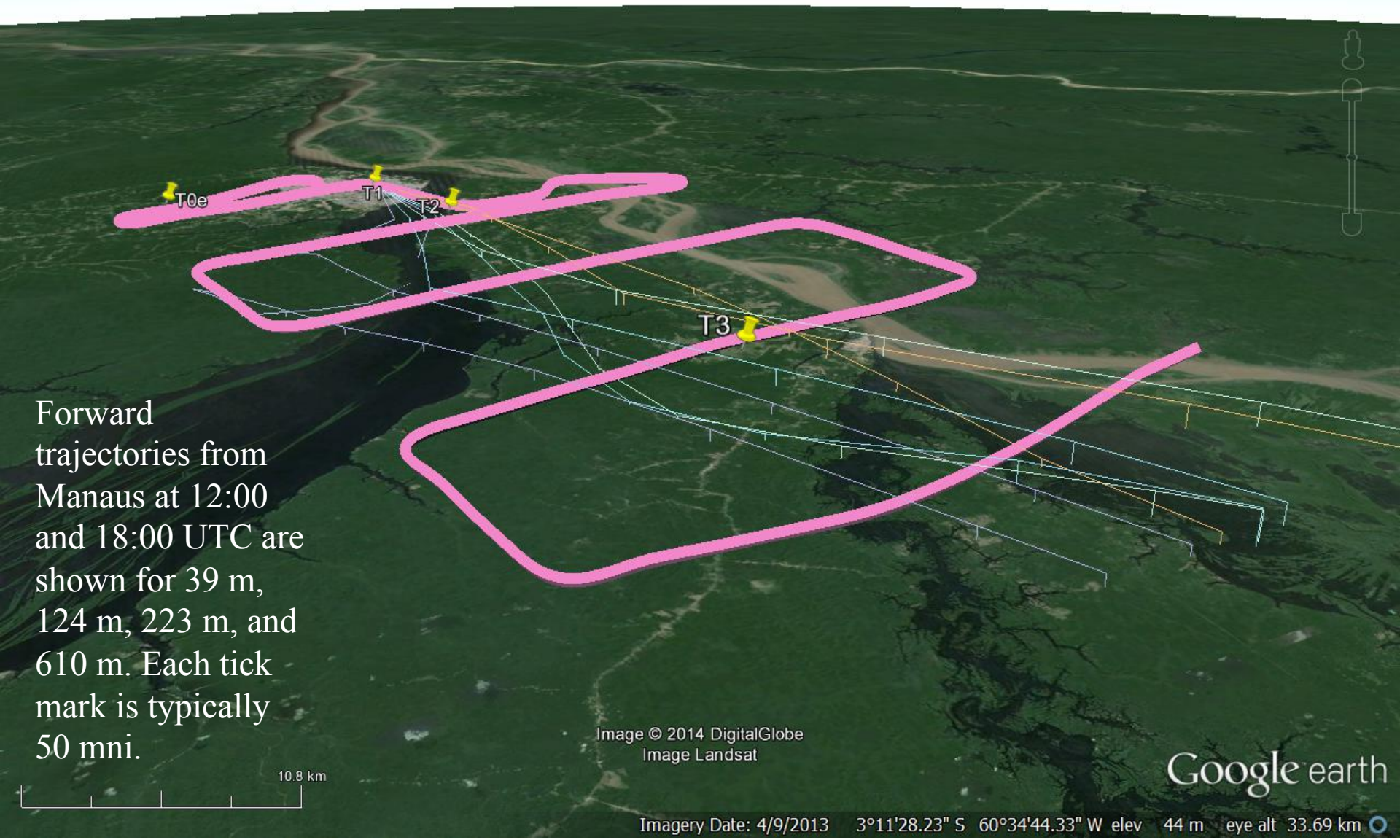
- 15 February until 26 March 2014 (wet season). Part of IOP1.
- 1 September until 10 October 2014 (dry season). Part of IOP2.

All Flight Paths of IOP 1

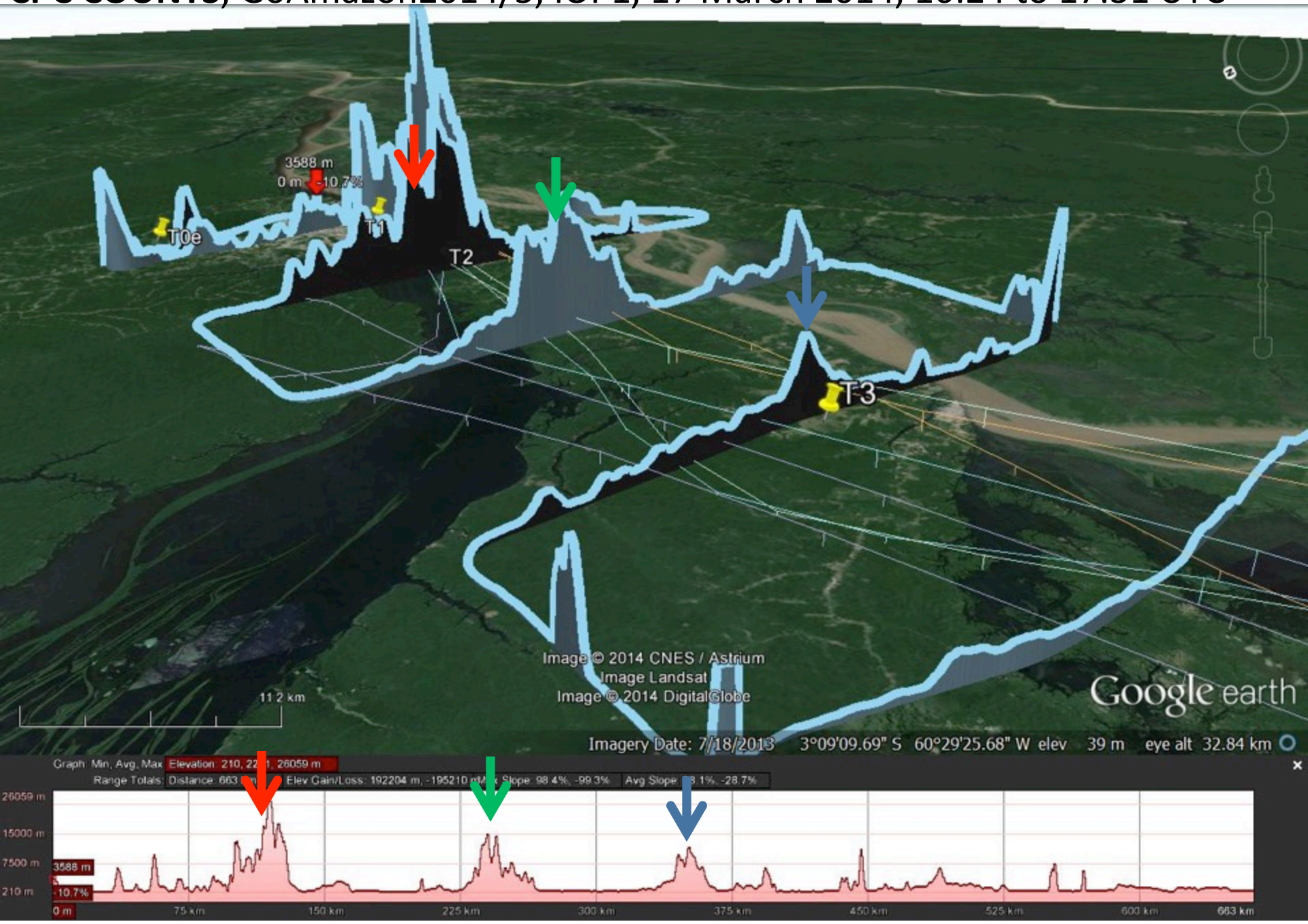
FLIGHT TRACK, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



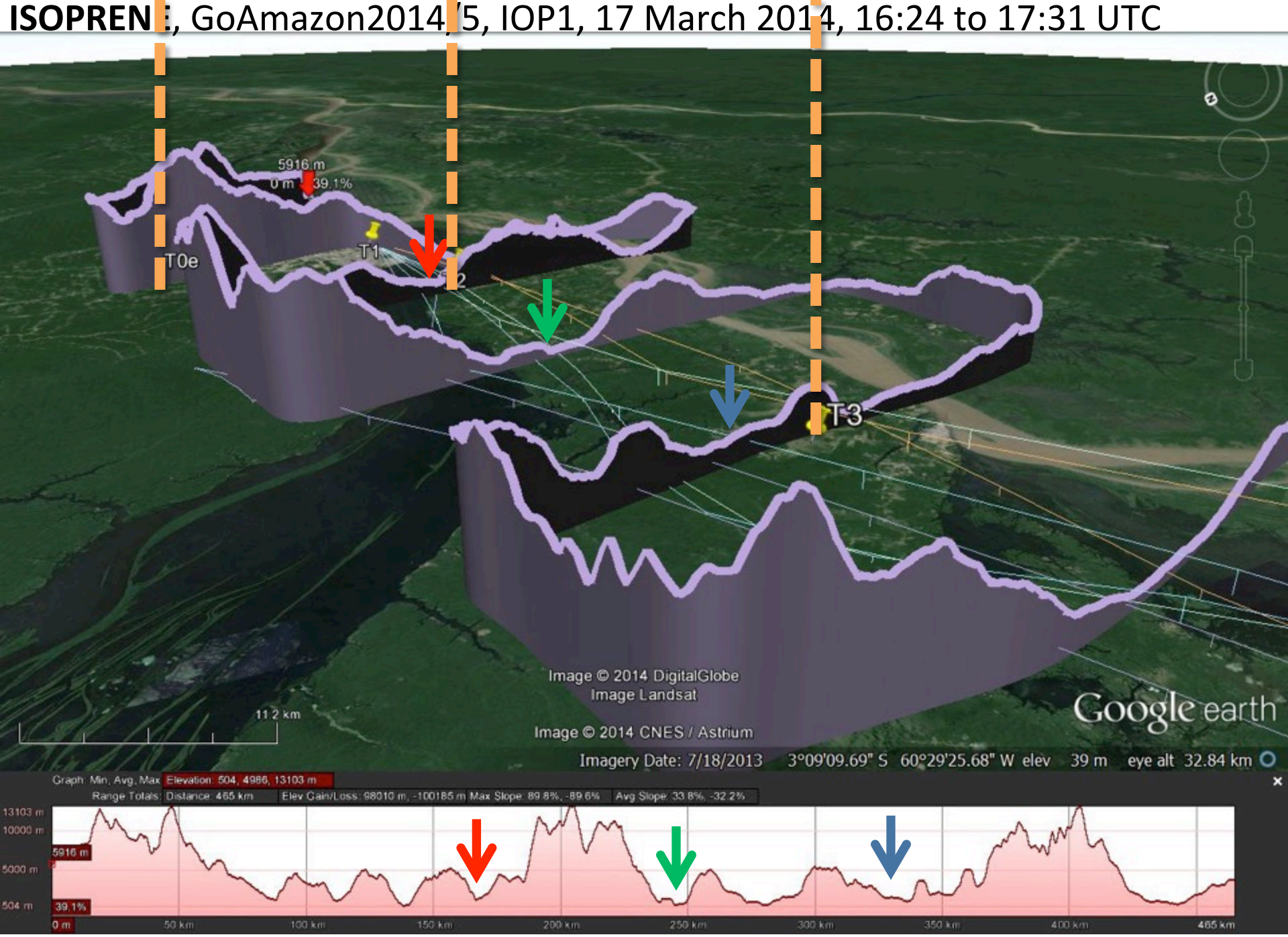
FLIGHT TRACK, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



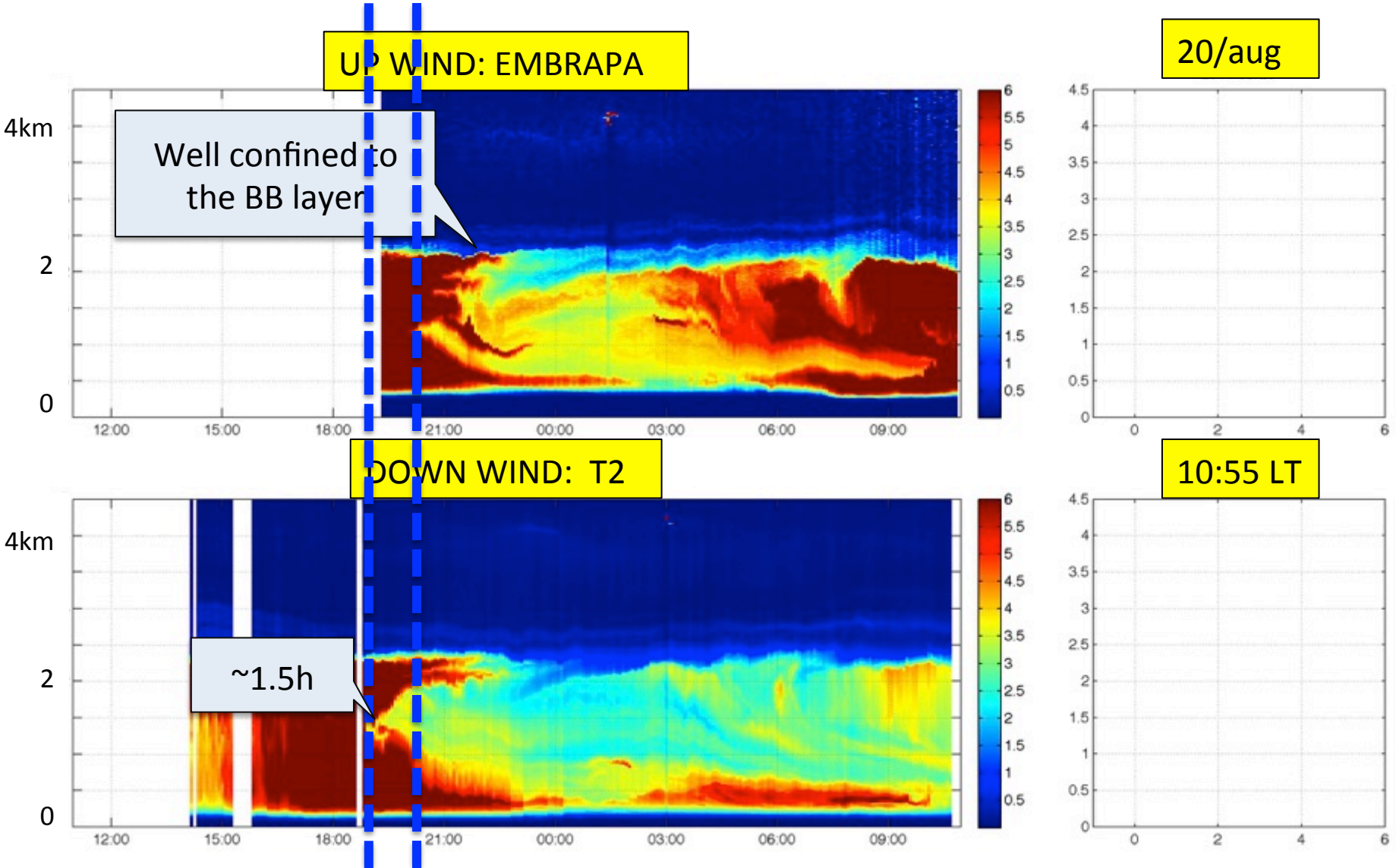
CPC COUNTS, GoAmazon2014/5, IOP1, 17 March 2014, 16:24 to 17:31 UTC



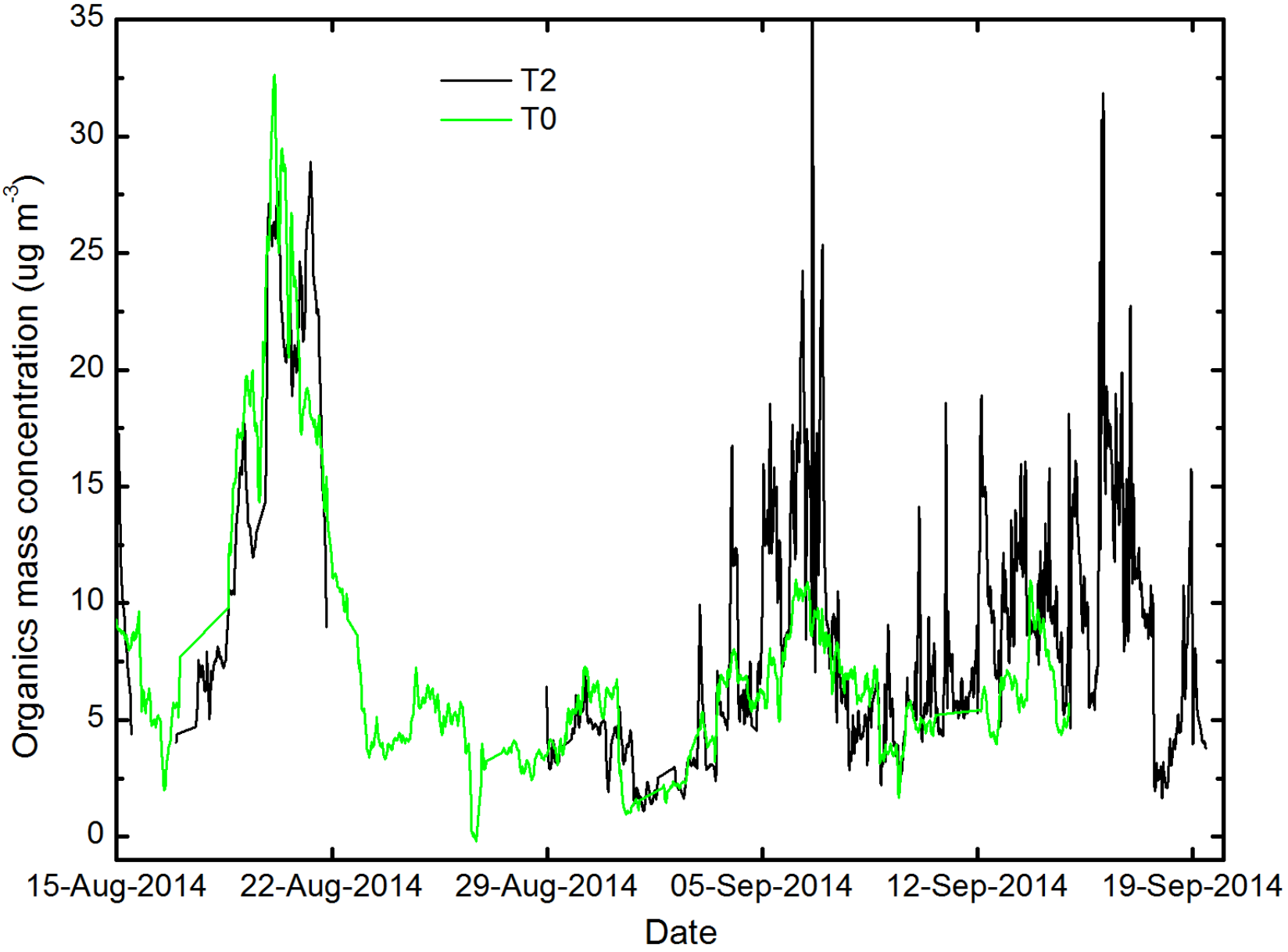
ISOPRENE, GoAmazon2014/15, IOP1, 17 March 2014, 16:24 to 17:31 UTC



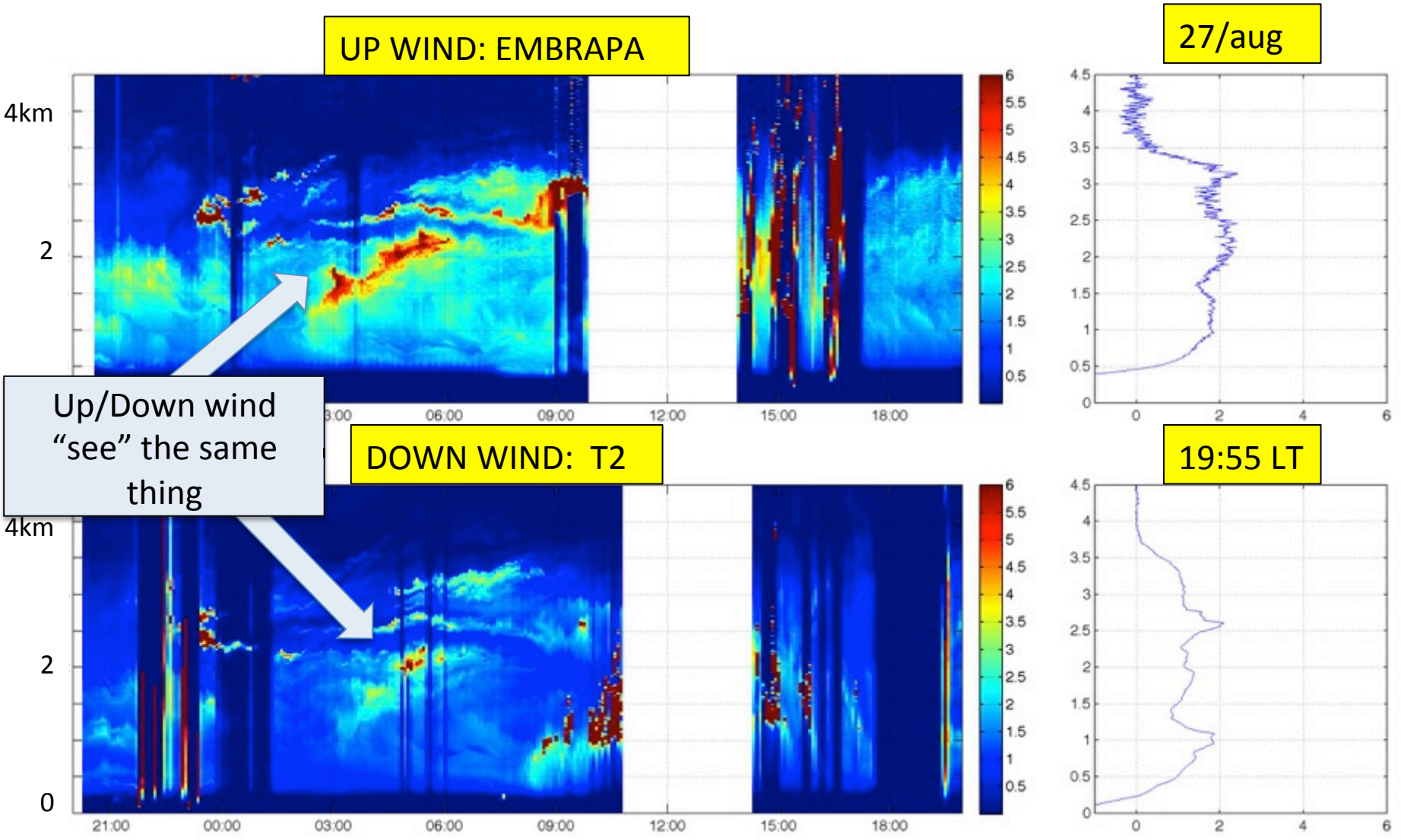
Backscatter (Mm^{-1}) vertical Profiles



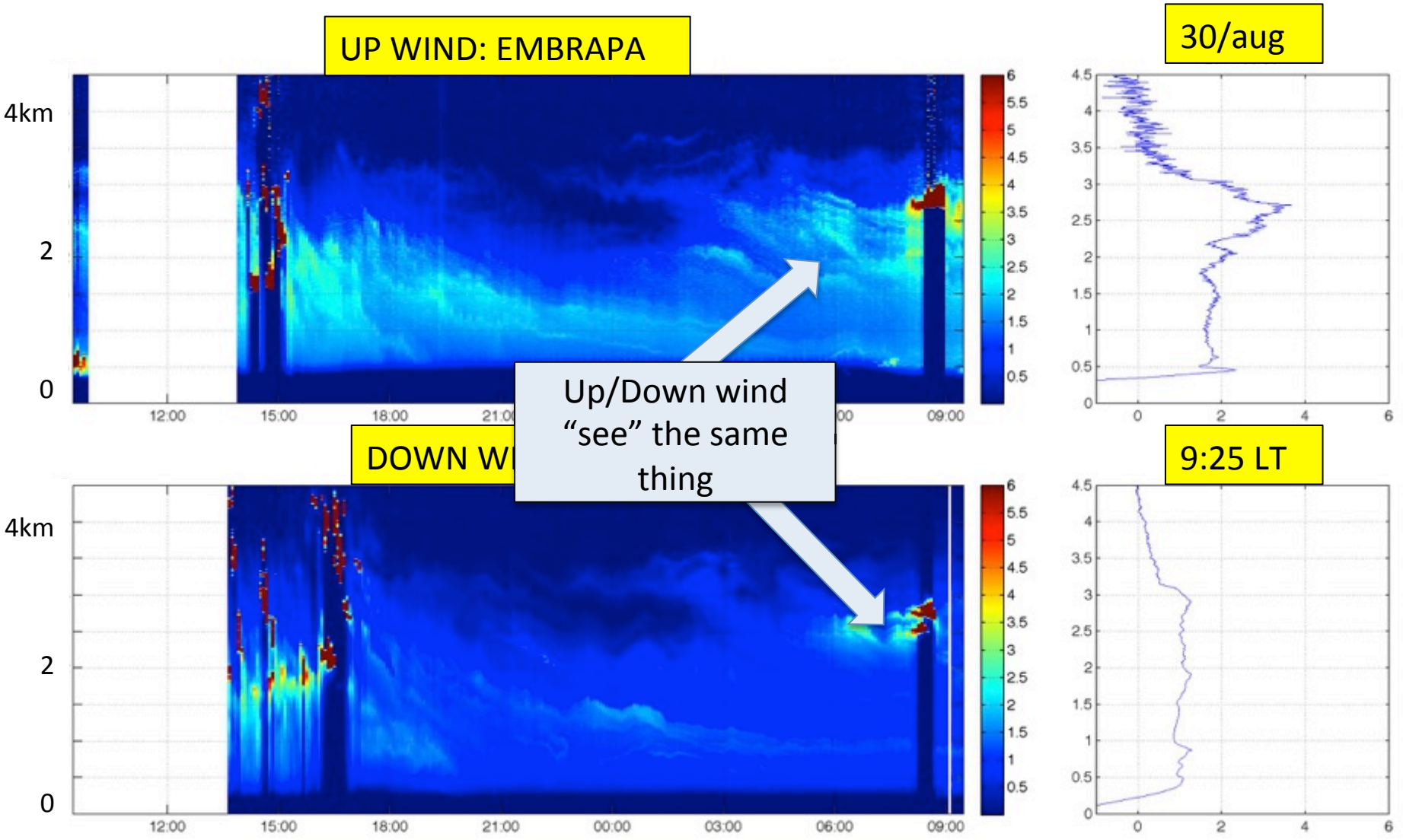
OA concentration – IOP2



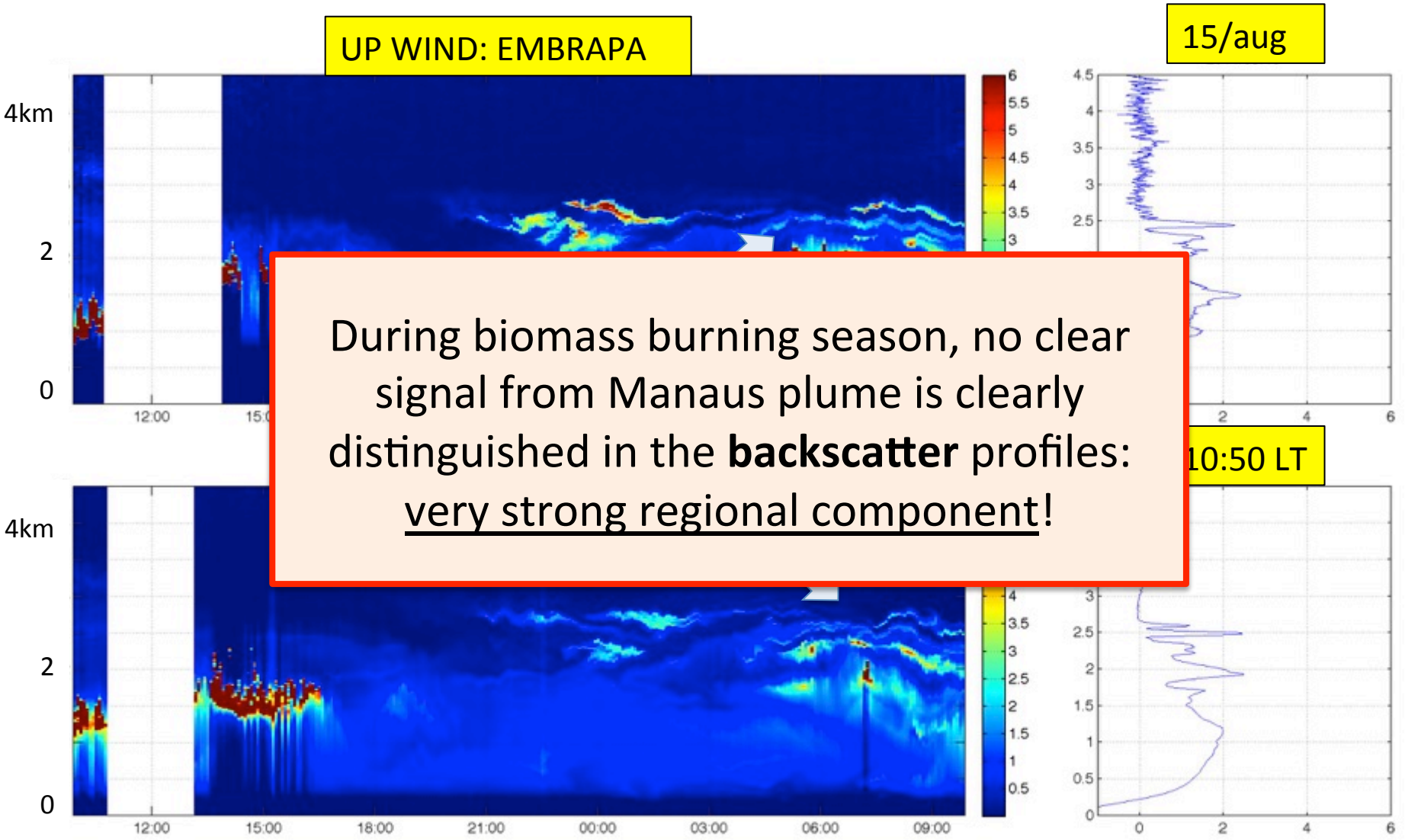
Backscatter (Mm^{-1}) vertical Profiles



Backscatter (Mm^{-1}) vertical Profiles



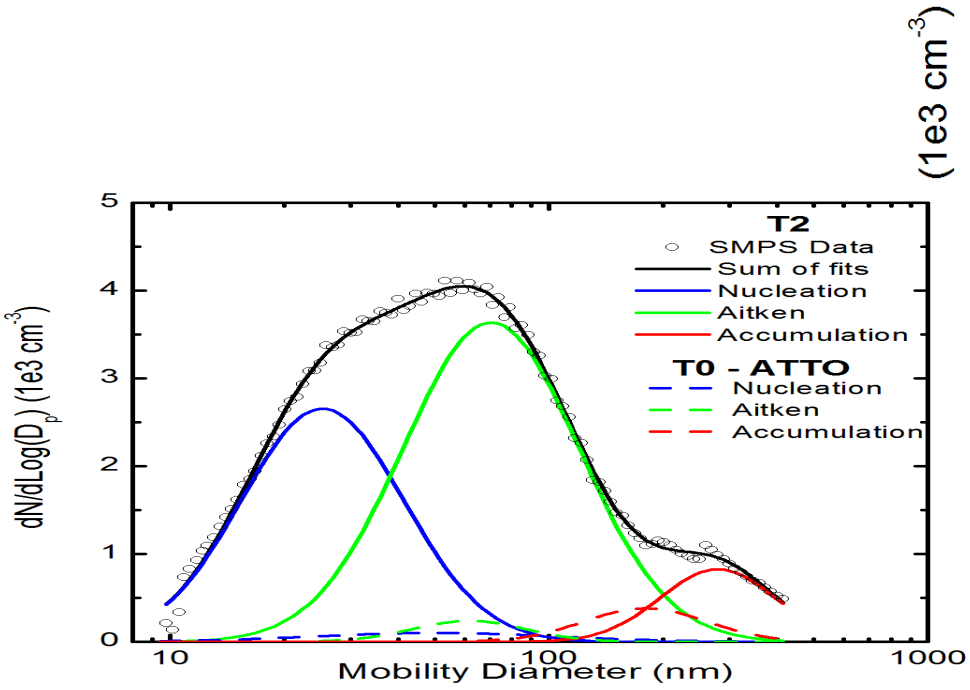
Backscatter (Mm^{-1}) vertical Profiles



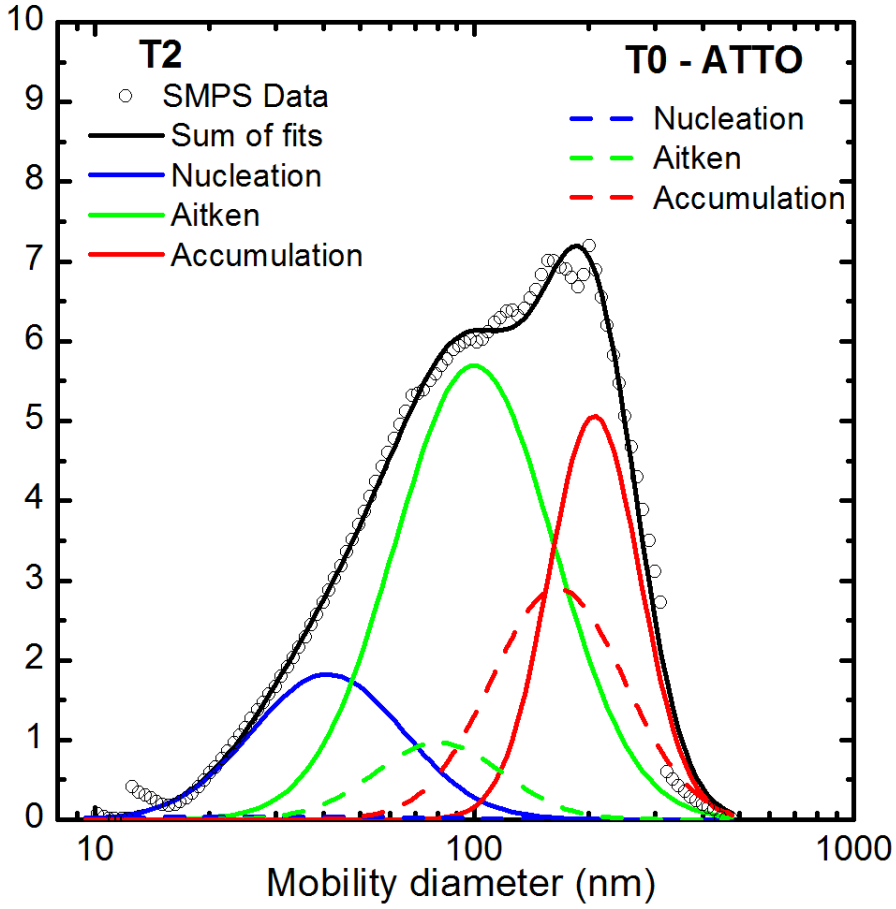
During biomass burning season, no clear signal from Manaus plume is clearly distinguished in the **backscatter** profiles: very strong regional component!

Size distribution

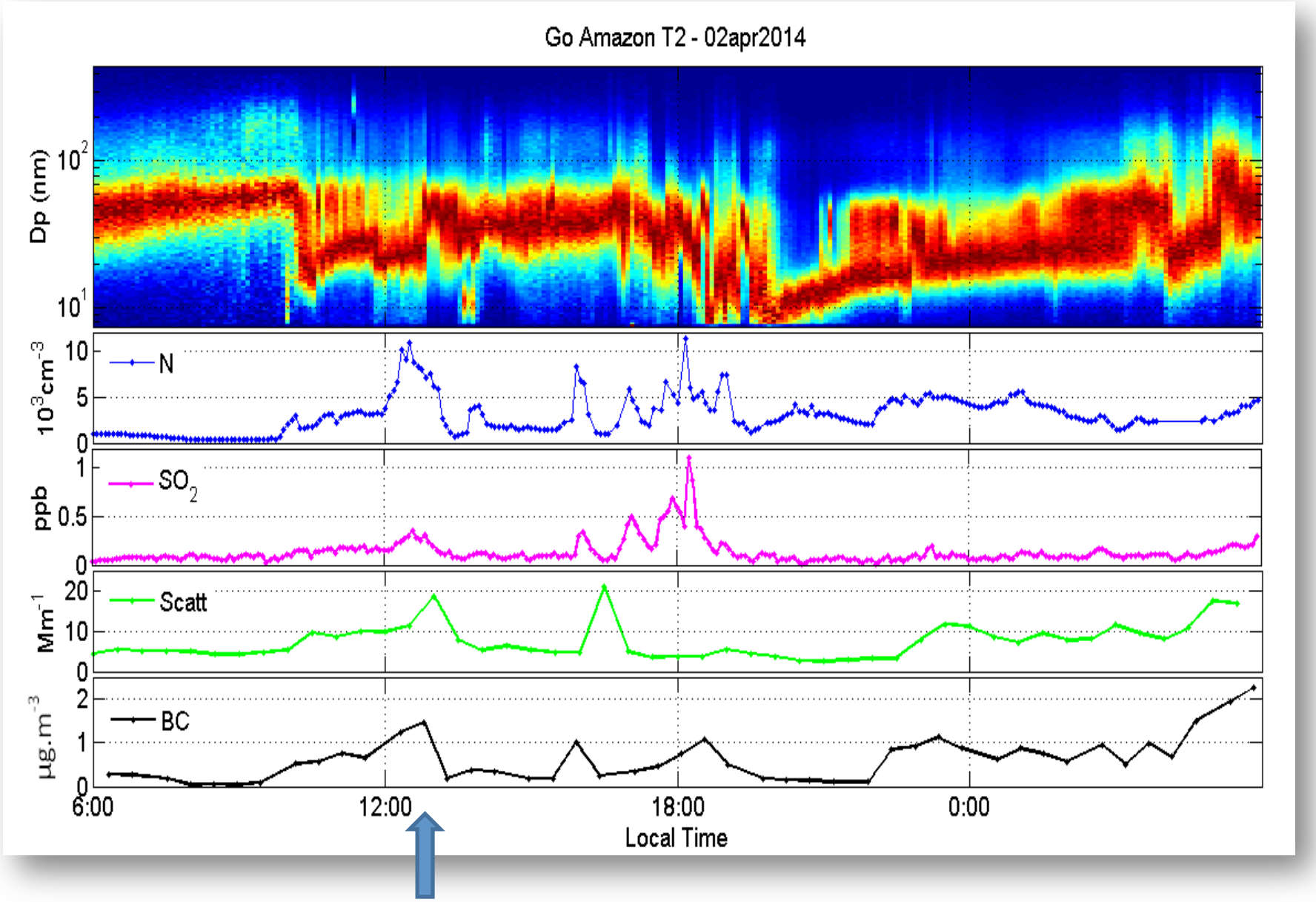
Wet season – IOP1



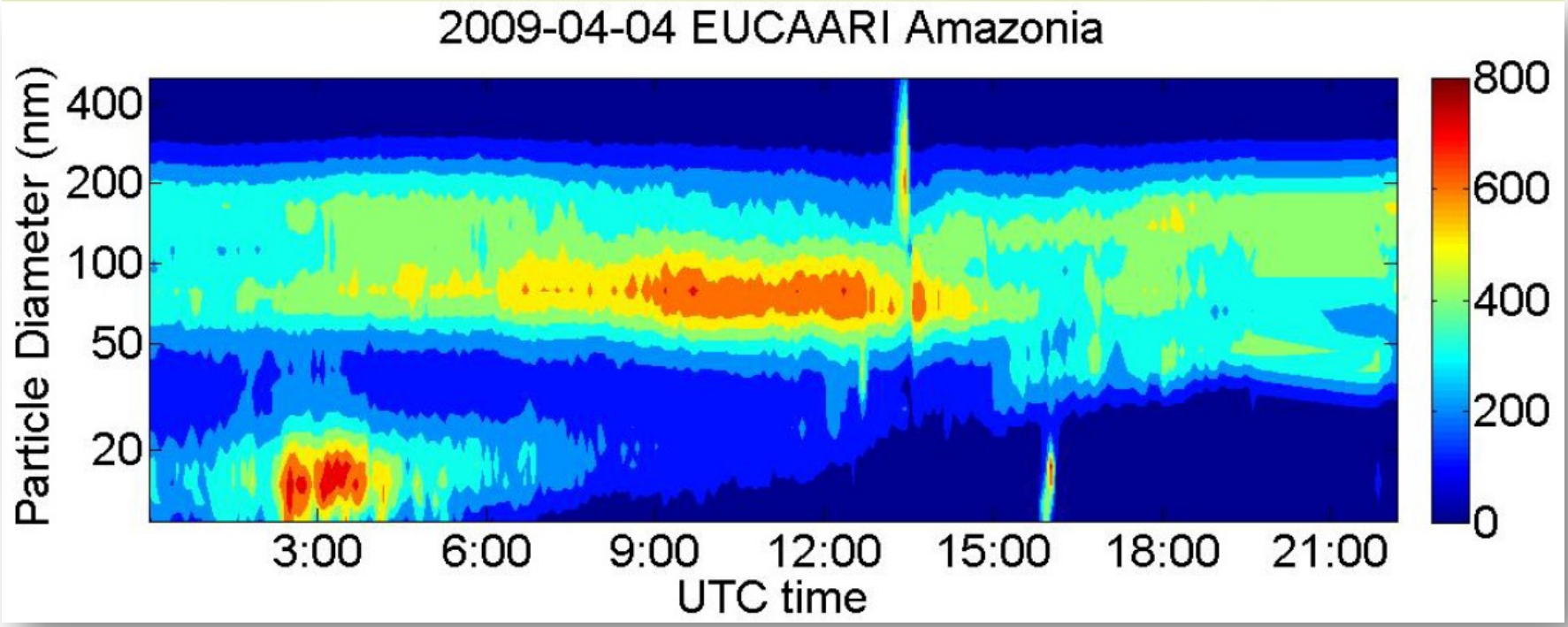
Dry season – IOP2



T2 - Size distribution, number, SO_2, light scattering and BC

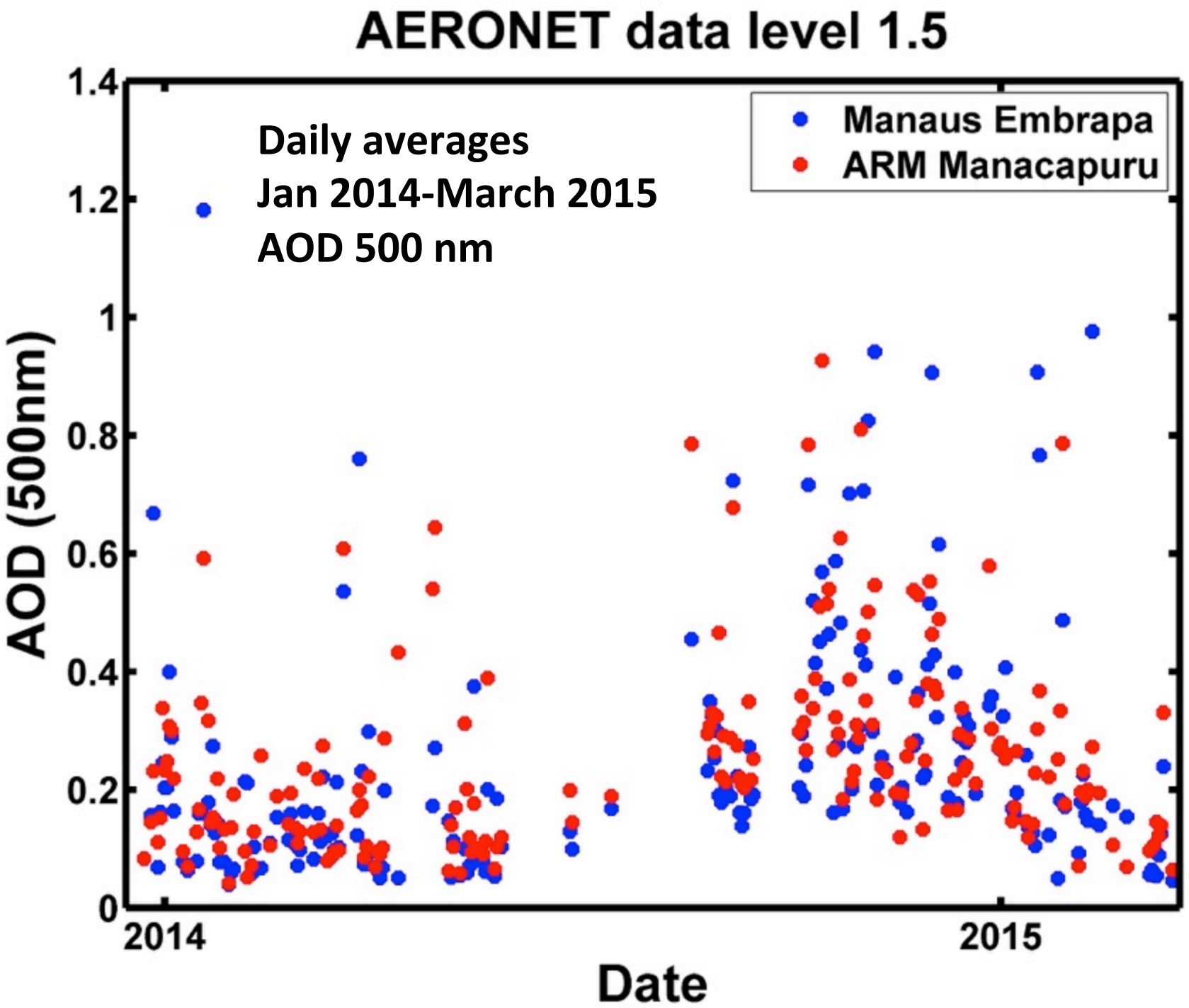


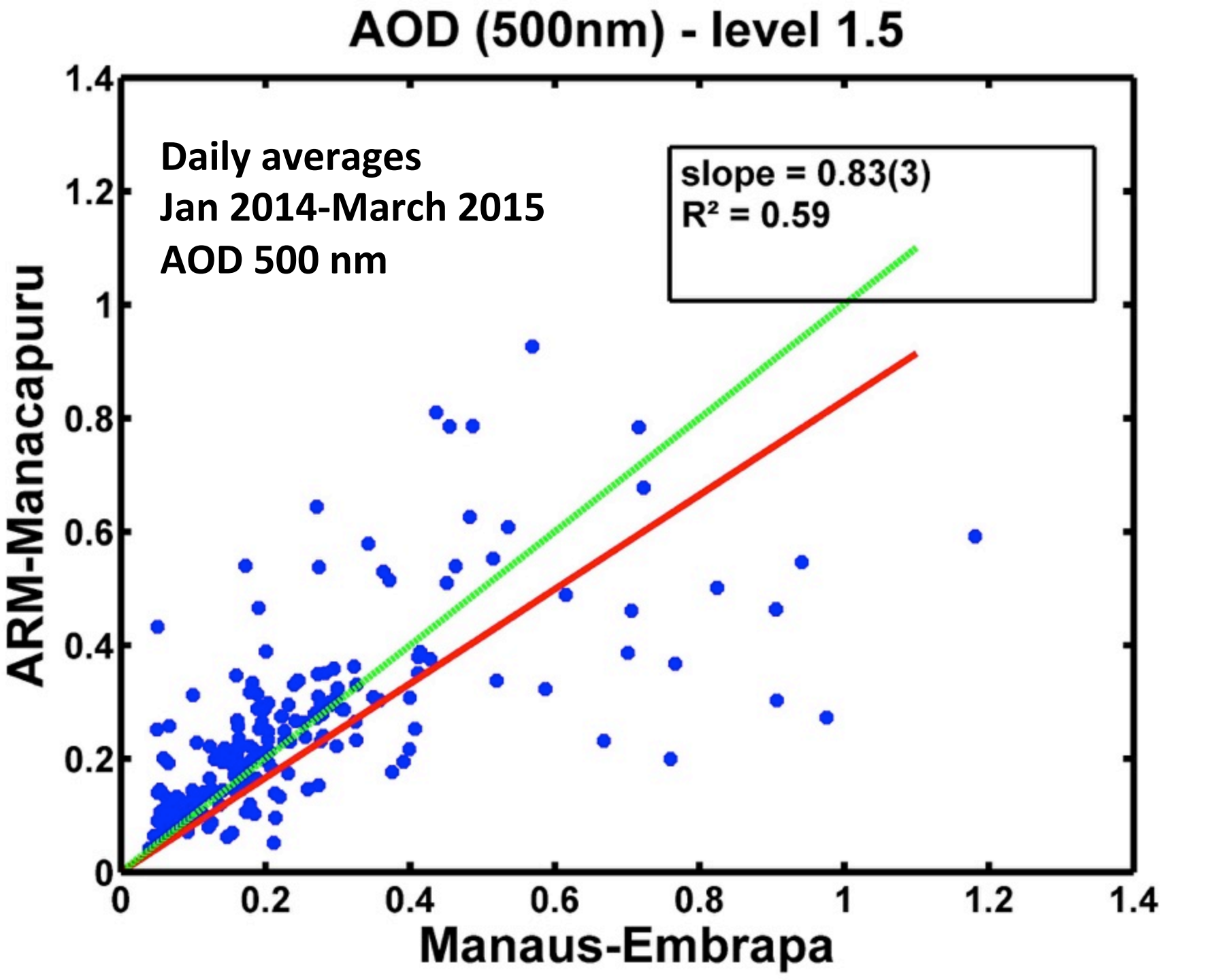
New particle formation? Bursts of particles $10<D_p<30$ nm.



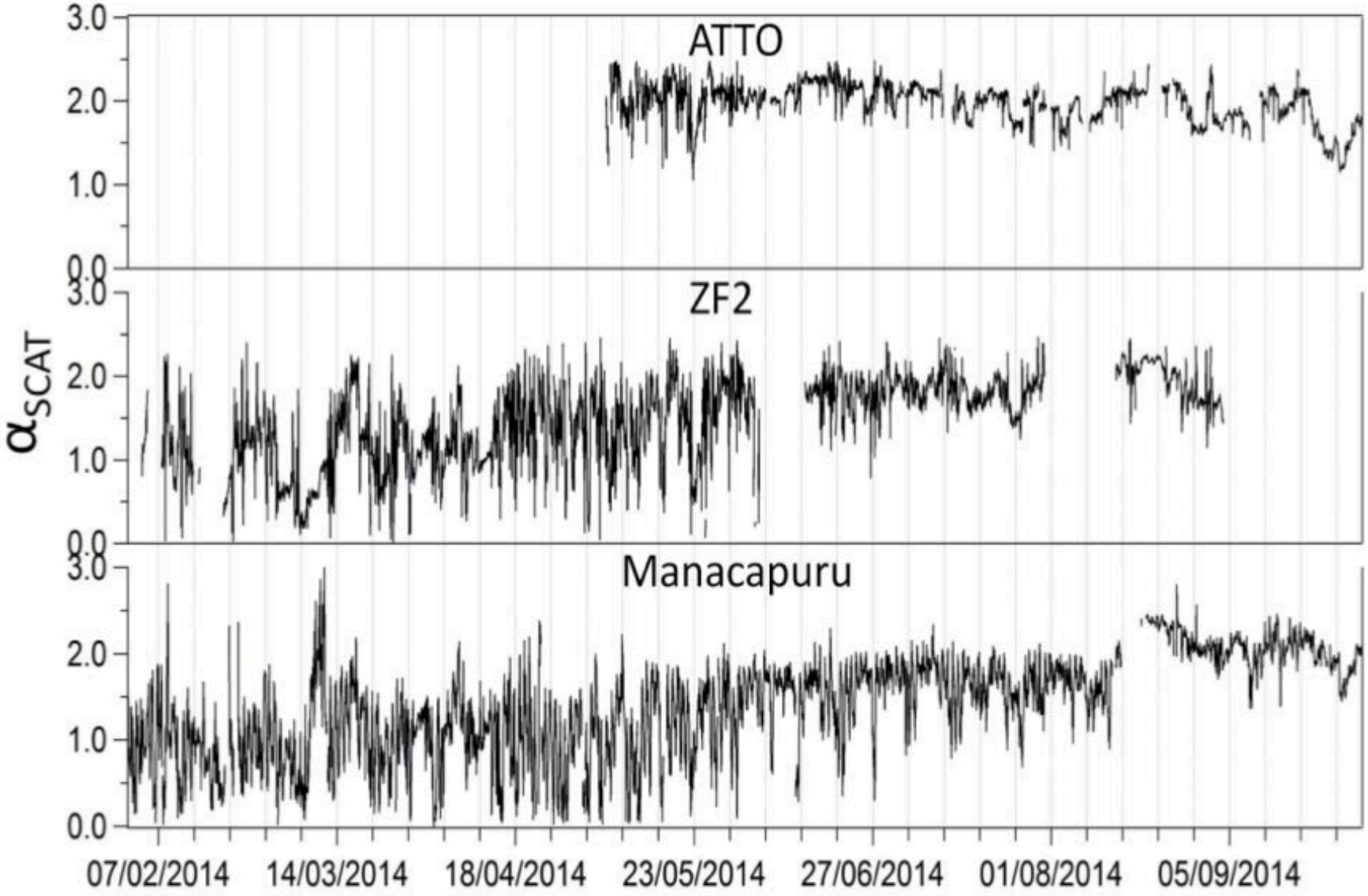
Aerosol size distributions measured in 2009 Apr 4th. There was a burst of ultrafine particles from 2:00 to 4:00 UTC time.

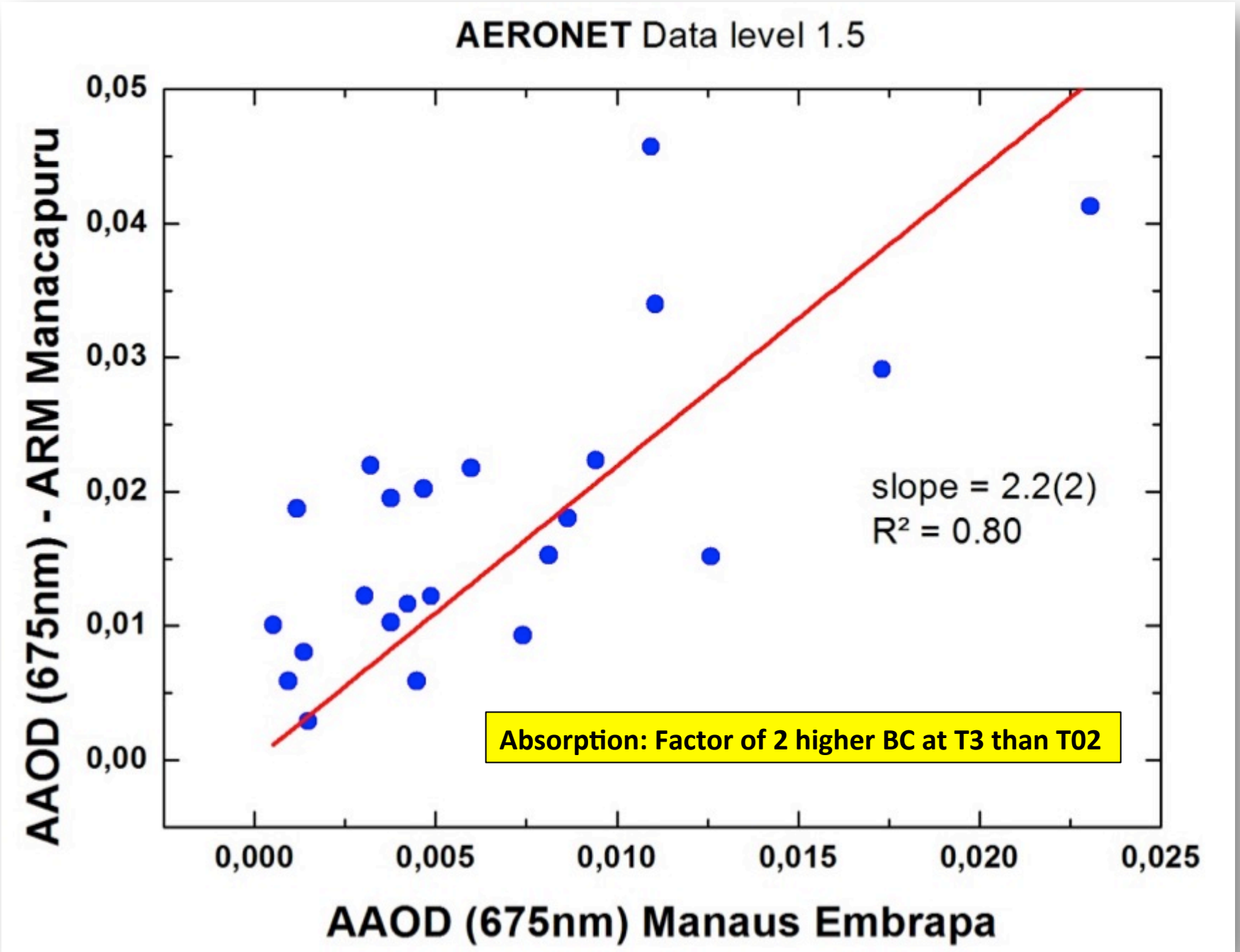
New particle formation and subsequent growth was seldom observed along two years of measurements. Nevertheless, in 70% of the days, bursts of particles with diameters in the range 10-40 nm were detected. The events usually lasted from 20 to 120min, and the subsequent growth to larger sizes was not always clearly observed.


AERONET data level 1.5
Daily averages
Jan 2014-March 2015
AOD 500 nm
Manaus Embrapa
ARM Manacapuru
AOD (500nm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2014
2015
Date

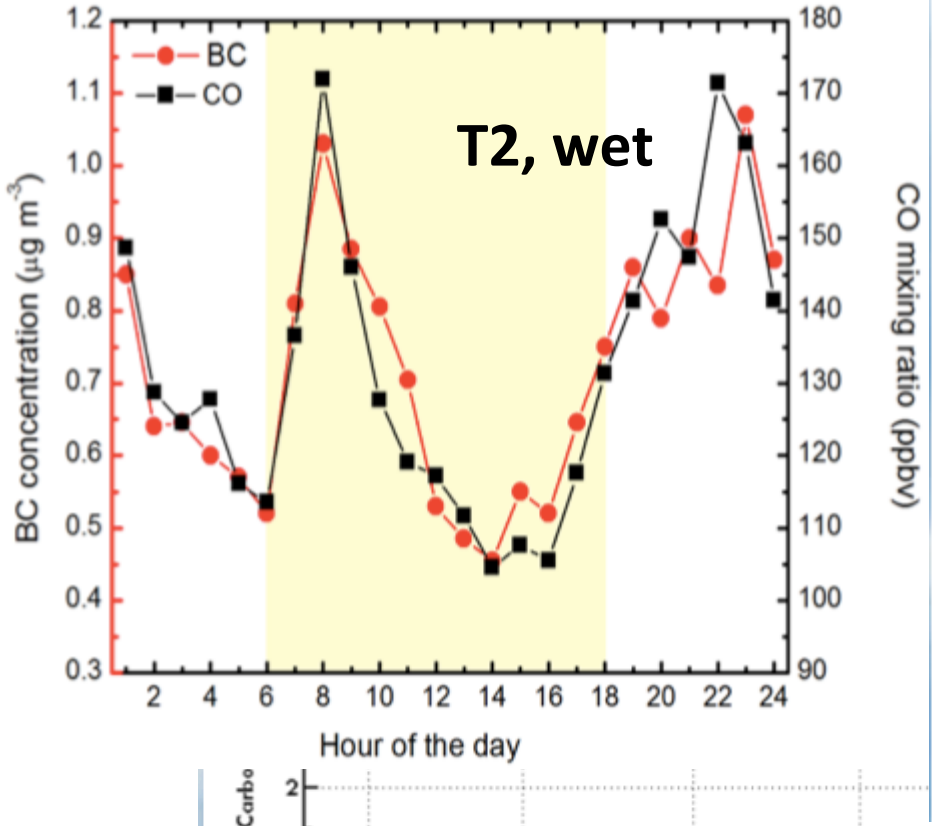

AOD (500nm) - level 1.5
Daily averages
Jan 2014-March 2015
AOD 500 nm
slope = 0.83(3)
R² = 0.59
ARM-Manacapuru
Manaus-Embrapa
0
0.2
0.4
0.6
0.8
1
1.2
1.4

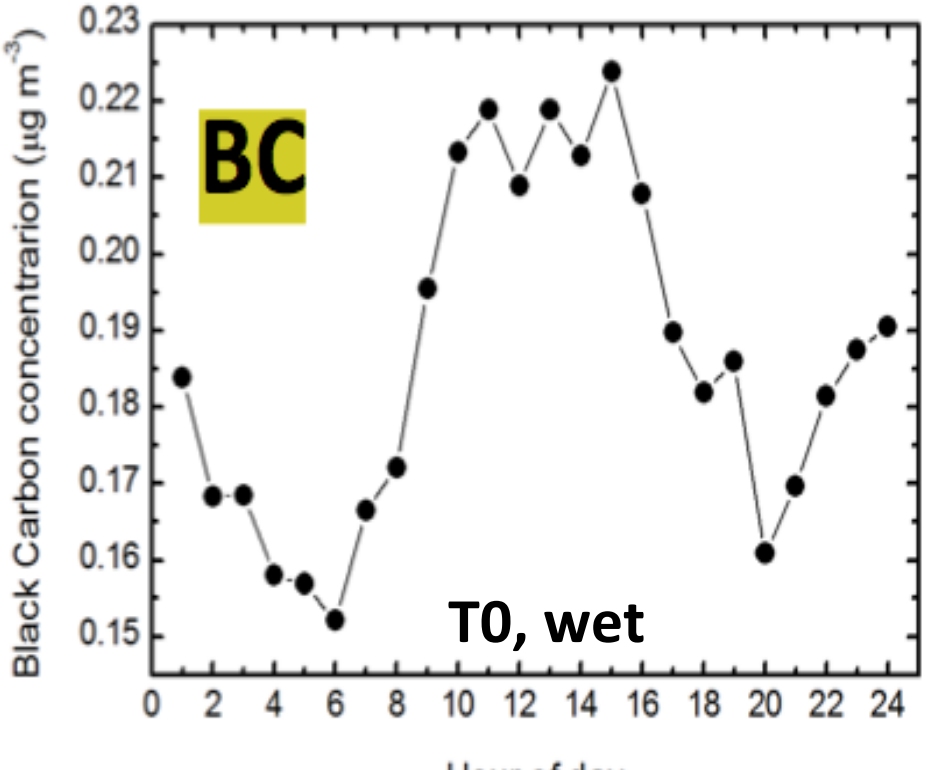
Light Scattering

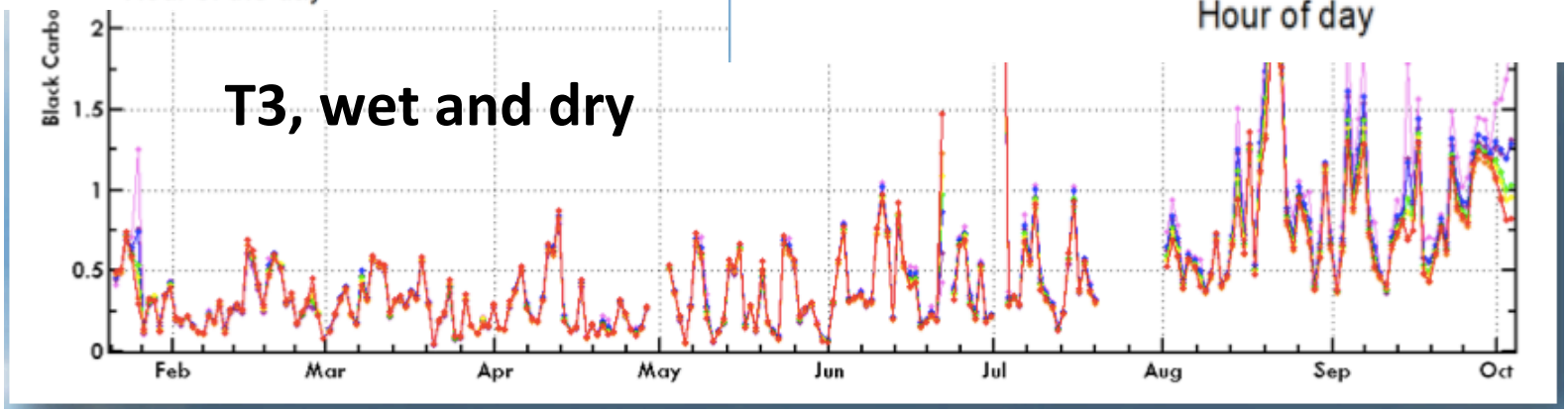



AERONET Data level 1.5
AAOD (675nm) - ARM Manacapuru
AAOD (675nm) Manaus Embrapa
0,05
0,04
0,03
0,02
0,01
0,00
0,000
0,005
0,010
0,015
0,020
0,025
slope = 2.2(2)
R² = 0.80
Absorption: Factor of 2 higher BC at T3 than T02

BC


BC
CO
T2, wet
BC concentration (μg m-3)
CO mixing ratio (ppbv)
Hour of the day


BC
T0, wet
Black Carbon concentrarion (μg m-3)
Hour of day


T3, wet and dry
Black Carbo
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct

Conclusions and Future perspectives

- Backscattering profiles from the up- and down-wind lidars do not show the Manaus plume
  - plume is composed of particles of small size that don't contribute much to scattering, but shows strong absorption

- We plan to do Raman inversion of the night-time data to check if we can see the plume in the extinction profiles